THE EXPLOSIVES ENGINEER

MAY-JUNE - 1960 VOL. 38 - NUMBER 3

NATIONAL SAFETY COMPETITION OF 1959

Gardner-Denver RP600 rotary portable compressors at work on sewer job.

Work 'em anywhere—in any weather Gardner-Denver rotary portables can take it

You can depend on Gardner-Denver rotary portable compressors to deliver the air you need in any weather—any climate, any altitude. They are ruggedly built, run smoothly, cost little to maintain. Six capacities from 85 to 900 cfm. Write for Bulletin RC-1. See your Gardner-Denver distributor soon.

All-weather operation—assured by efficient cooling system.

No dry starts in cold weather—clutch on RP125 and larger sizes assures full lubrication when compressor is engaged.

Thrifty—"THRIFTMETER"® fuel control regulates engine to meet air demands.

Easy to maintain—rotors and blades can be inspected and changed in minutes.

Gardner-Denver RP900 rotaries provide power for 5½" drills on Niagara power project.

GARDNER-DENVER Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

THE EXPLOSIVES ENGINEER

REG. U.S. PAT. OFF.

Forerunner of Progress in Mining, Quarrying, Construction

CONTENTS

RICHARD A. YOUNG—*a photograph* 68

RICHARD A. YOUNG—*a biography* 69

The Winners in 1959 70

The National Safety Competition of 1959 71
By JOHN C. MACHISAK

Awards of Certificates of Achievement in Safety – 1959 79

New York Trap Rock Quarry Wins NCSA and THE EXPLOSIVES ENGINEER Plaques 80

Jugtown Mountain Cut 82
By DON GOODMAN

Quarrying Limestone in the Hudson Quarry of Universal Atlas 88
By L. J. PAULY

News Notes 94

Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publishers.

In his article starting on page 71, John C. Machisak, chief, Branch of Accident Analysis of the U. S. Bureau of Mines, summarizes the highlights of the National Safety Competition of 1959. Several notable achievements in safety performance are noted in Mr. Machisak's report.

Mines and quarries participating in the 1959 competition established a new record-low frequency rate of 18.293 disabling work injuries per million man-hours of exposure.

Another noteworthy achievement was the establishment of a record number of participants—280—that operated throughout the year without a disabling work injury.

Interest in the competition remains high. The number participating—672—was only three below the record of 675 established in the 1958 competition.

The competition is conducted annually by the Federal Bureau of Mines in cooperation with THE EXPLOSIVES ENGINEER. Each of the six winning operations—five mines and one quarry—is awarded a bronze Sentinels of Safety trophy, provided by THE EXPLOSIVES ENGINEER, which is retained by the winner for one year. A green-and-white Sentinels of Safety flag is also awarded each winning operation.

The editorial staff of THE EXPLOSIVES ENGINEER joins with the entire mineral industry in extending congratulations to the winners, and best wishes to all participants for their sincere safety efforts.

* * *

A highlight of the recent National Crushed Stone Association convention was the presenting of the NCSA safety award to 33 member quarries having perfect safety records.

For the first time the contest was divided into five groups based on total man-hours worked. This was to stimulate interest on the part of the smaller operators who in the past had little chance of recognition.

For details of this safety program, please turn to page 80.

* * *

An interesting road excavating job is in progress in the mountains of northern New Jersey. It is interesting both from a topographical as well as a procedure standpoint. The highlight of the 4.8-mile excavating and grading contract held by Yonkers Contracting Company is the Jugtown Mountain area where Interstate Route 78 cuts through a rise 800 ft. high, one of the highest points in New Jersey. The cut will be 120 ft. deep, ½ mile long, and 150 ft. wide.

Yonkers Contracting Company's procedure of preventive maintenance, smooth, well-compacted haulageways, and blasting to achieve well-fragmented rock is really paying off. The job is now 85% completed and six months ahead of schedule. Don Goodman tells how Yonkers is making this progress in his article starting on page 82.

* * *

Up in New York State along the Hudson River is a quarry that is steeped in historic interest. For many years, well over 75, the Hudson Quarry, now operated by Universal Atlas Cement Division of United States Steel Corporation, has been producing stone for construction and cement. Much of the stone for the foundation of the Brooklyn Bridge, opened in 1883, came from this quarry.

L. J. Pauly, in an article starting on page 88, describes the historical background of this quarry and tells of current operation procedures that have made this quarry a model of efficiency in planning and operating techniques.

EDITORIAL STAFF: JAMES J. O'NEILL, *Editor;* THOMAS E. MILLER, *Associate Editor;* GERTRUDE A. DONNELLY, *Associate Editor;* EDWARD L. GRANT, *Art Editor;* HOWARD B. DICKSON, *Production Manager;* A. J. ACKERMAN, *Advertising Manager;* MONTGOMERY R. BUDD, *Director.*

SUBSCRIPTION RATES: *United States and Canada*—One Year, $1.50; Single Copies, $.30; *Limited Subscriptions Only to Other Countries*—One Year, $2.50; Single Copies, $.50.

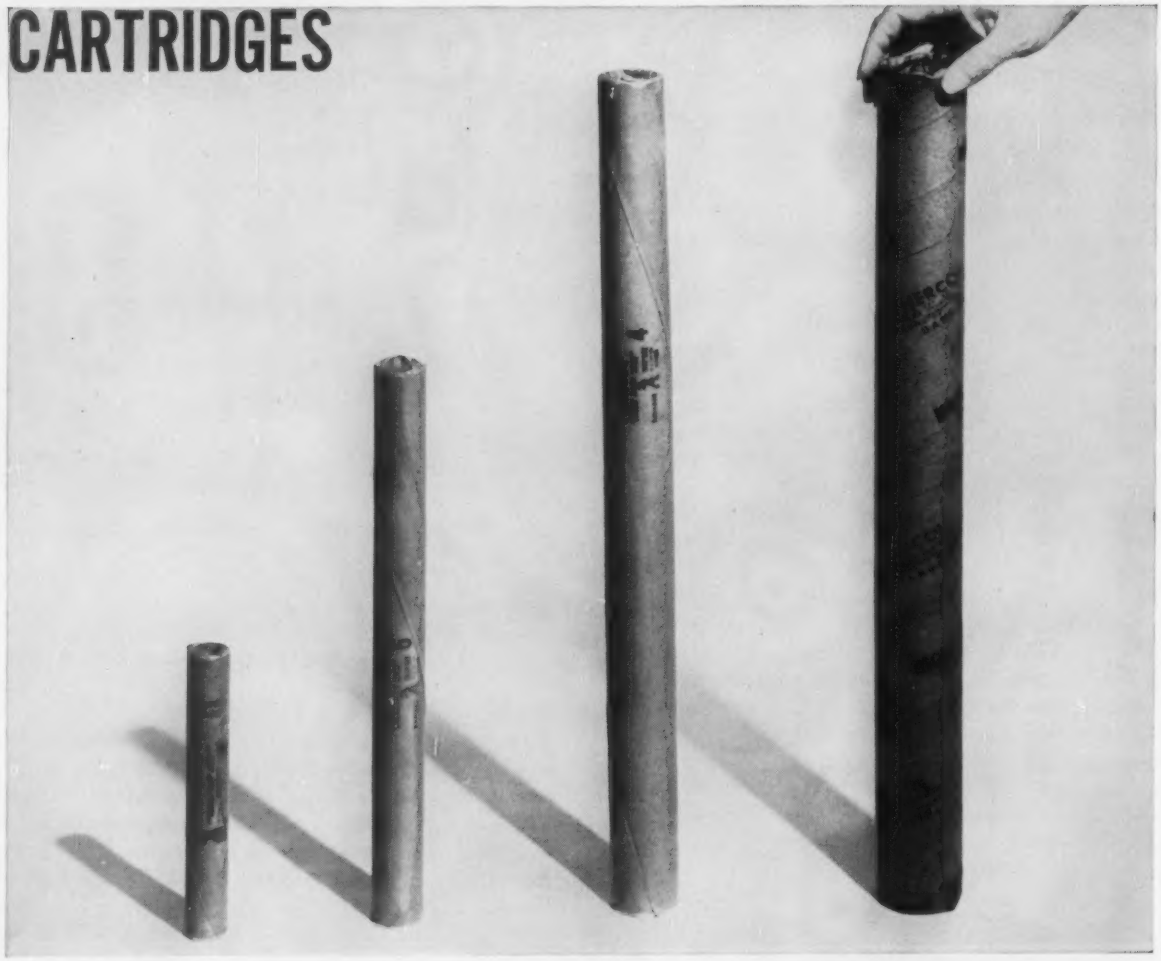
THE EXPLOSIVES ENGINEER, 613 DELAWARE TRUST BUILDING, WILMINGTON, DELAWARE. PRINTED IN UNITED STATES OF AMERICA.

PUBLISHED BY *HERCULES POWDER COMPANY*
INCORPORATED

© HERCULES POWDER COMPANY, 1960

VOL. 38 NO. 3 MAY-JUNE, 1960 BPA

HERCOL®—A LOW-COST EXPLOSIVE—NOW AVAILABLE IN SMALL-DIAMETER CARTRIDGES



The Hercol series of low-cost, cap-sensitive, high-ammonia-content explosives are now available in cartridges of small diameters and standard lengths, as well as in the larger diameters and special packings.

The ability of Hercol to produce excellent fragmentation, its water resistance, Class 1 fumes, and high cartridge count—plus its low cost—have already been proved to the economy-minded quarry and open-pit operator.

Now that Hercol is manufactured in the smaller diameters, with Class 1 fumes, these same economies are available to the underground operator.

Contact the Hercules sales office nearest you or ask your Hercules representative for more detailed information on how Hercol can reduce blasting costs for you, too.

Properties of Hercol

	Hercol	Hercol 2	Hercol 4	Hercol 6
Fumes	Good	Good	Good	Good
Cartridge count—1¼ by 8-in. cartridges per 50 lb.	130	120	140	165
Cartridge diameter, in.	4 to 8½	1 to 3½	1 to 3½	1 to 3½
Weight strength, %	70	63	68	68
Cartridge strength, %	48	50	34	19
Water resistance	Fair	Good	Fair	Fair

A special grade of Hercol is formulated for seismic "pattern shooting" when the drill-holes are relatively dry.

Explosives Department
HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington, Delaware

XR60-1

BIRMINGHAM · CHICAGO · DULUTH · JOPLIN · LOS ANGELES · NEW YORK · PITTSBURGH · SALT LAKE CITY · SAN FRANCISCO

how many hours per week do your crawler drill rigs just...

sit?

Here's one way to get more productive hours from the dollars you tie up in blast hole equipment: Switch from crawlers to work-and-run truck-mounted rigs . . . like the Speedstar 30-AW.

With *one* truck-mounted 30-AW, you can handle heavy-duty blast-hole drilling at *several* scattered pits . . . do exploration and core sampling work whenever and wherever needed . . . make extra profits handling water-well or other contract drilling. Yet, the versatile 30-AW compares favorably in cost with crawler rigs of comparable production capacity.

To investigate the possibilities further, send coupon for new Stardrill-Keystone bulletin on truck-mounted all-purpose rotary drill rigs. Mail coupon to:

STARDRILL-KEYSTONE
Buffalo-Springfield Co., Springfield, Ohio
(A Division of Koehring Co.)

The 30-AW is a combination air-water rotary . . . handles all current makes of down-the-hole guns. Larger companion models available with PTO or outboard . . . plus many other rotary and cable tool models.

SPECIFICATIONS

30-AW Combination Rotary Gun Drill

CAPACITY: Air-drilling . . . up to 500 feet of 6 inch hole, 100 feet of 8¾" hole. Fluid drilling . . . up to 1000 feet of 6" hole.

ENGINE: Outboard Model 6031-C GMC Diesel, 6-cylinder with standard accessories.

ROTARY TABLE: Mechanical drive gives you 10 times more torque, 15% faster drilling speeds than hydraulic types . . . at same time, cuts maintenance costs.

PULLDOWN: Manual control, automatic feed, chain operated with 4-speed transmission, 25,000 pound pulldown.

AIR COMPRESSOR: Two-stage, 6-cylinder, 500 cu. ft. @ 100 lbs., completely equipped with valves, storage tank and fittings.

MUD PUMP: A 4 x 5 centrifugal pump, complete with companion flanges, lubricator, suction and discharge hoses.

DERRICK: Round, tubular construction, 30,000 pound working capacity, accommodates 20' kelly, 15' drill pipe.

LEVELING JACKS: Hydraulic, one front, two rear. Operated from operator's position.

Yes, send copy of rotary drill bulletin to . . .

NAME..... TITLE.....
COMPANY.....
ADDRESS.....
CITY..... STATE.....

EE SK12

RICHARD A. YOUNG

Richard A. Young

VICE PRESIDENT

AMERICAN ZINC, LEAD AND SMELTING COMPANY

A Biography

THE best way to become a miner is to be born into the business. That way you learn mining in the cradle, at your mother's knee, and under your father's watchful eye if he also is a miner. Richard A. Young, vice president of American Zinc, Lead and Smelting Company, learned mining from the ground up in this manner. When his father, Howard I. Young, now president of the company, was manager of the company's Missouri mines, Richard was born in Carthage, the center of the American zinc business then as it is now. As his father moved to the mining camps at Mascot, Tennessee, and Silver Dyke, Montana, young Richard followed along, picking up the elements of mining in the field. When he was fourteen, his father was elected company president and took the family to St. Louis, Missouri, where Dick's mining education became somewhat more academic.

He attended the public schools in Tennessee and graduated from John Burroughs, a private school in St. Louis, in 1932. Here he showed his flair for football, where he was captain of the team, and perhaps for that reason, he was also president of his senior class.

At Washington University in St. Louis he played guard, and won his letter three years in a row, and found time to be president of Phi Delta Theta, president of the sophomore honor fraternity, and make the Quad Club, the student musical comedy group.

Dick graduated from Washington University in 1936 with a Bachelor of Science degree in chemical engineering, and then went on to the Harvard Graduate School of Business Administration, where he obtained his master's degree.

Meanwhile, he had been a summertime worker for American Zinc since the age of twelve, first on the company farm, and subsequently as laborer, carpenter, sampler, furnace operator, chemist, and metallurgist. Following his graduation from the Harvard Business School, there was only one place for a man of his training to go to work and that was American Zinc, where he became assistant to the plant manager at Fairmont City (East St. Louis), Illinois. In 1940, the company sent Dick to Dumas, Texas, where the company had acquired a small retort zinc smelter, to start up the plant and operate it. Because of the war, production was expanded from 12,000 to 50,000 tons annually.

Near the end of the war Dick was named vice president of the company's smelting subsidiary, and in 1950 vice president of the parent company. Five years later American Zinc purchased an interest in the newly formed Uranium Reduction Company and signed a contract to manage the operations and finances of the new company. He then had the additional responsibility of administering this contract for American Zinc, and the job of executive vice president and director of Uranium Reduction. American Zinc designed and built the large uranium mill at Moab, Utah, which by 1957 had become the largest producer of U_3O_8 in the United States.

Dick has an impressive service record with American Zinc now for, counting his summer work as a boy, he has been with them thirty-two years. He is a member of all of the mining societies, a member of the board of governors of the American Mining Congress, and former chairman of the Lead and Zinc Subcommittee of the Extractive Division of the American Institute of Mining and Metallurgical Engineers. Since 1958 he has been industry advisor to the U. S. delegation to the United Nations Conference on Lead and Zinc, and a member of the United Nations Lead-Zinc Study Group. He is a director as well as vice president of American Zinc, Lead and Smelting Company.

He married Janice Westmoreland in Amarillo, Texas, in 1945, and they have three children: Harriette Louise, twelve; Richard, Jr., nine; and Alfred Westmoreland, aged one. The family lives at 30 Clermont Lane, Clayton 24, Missouri.

The Winners in 1959

Anthracite
STOCKTON MINE
JEDDO-HIGHLAND COAL COMPANY
Stockton, Pennsylvania

Bituminous-Coal
HARWICK MINE
DUQUESNE LIGHT COMPANY
Harwick, Pennsylvania

Metal
WAUSECA MINE
THE HANNA MINING COMPANY
Iron River, Michigan

Nonmetallic
CLARENCE CENTER MINE
BESTWALL GYPSUM COMPANY
Akron, New York

Open-Pit
ROUCHLEAU MINE
OLIVER IRON MINING DIVISION
UNITED STATES STEEL CORPORATION
Virginia, Minnesota

Quarry
PORT INLAND QUARRY
INLAND LIME AND STONE COMPANY
DIVISION OF INLAND STEEL COMPANY
Gulliver, Michigan

"Let the worker carry around with him a mental picture of his wife and child, whose happiness depends upon his safe return after the day's work, and these loved ones become his surest sentinels of safety."

The Explosives Engineer—January, 1925

The National Safety Competition

OF NINETEEN FIFTY-NINE

Mine and quarry entrants again establish a new record-low frequency rate of 18.293; severity rate third lowest of contest history

JOHN C. MACHISAK*

TOP MANAGEMENT of the nation's mining and quarrying industries once again has successfully met the historic challenge to its ingenuity—that of reducing disabling work injuries among its employes. The effectiveness of management's ability in meeting this problem, and thus discharging some of its humanitarian responsibility, is clearly evident from a review of the records of the 1959 National Safety Competition. Participating mines and quarries in this, the 35th annual National Safety Competition, established a new record-low frequency rate of 18.293 disabling work injuries per million man-hours of exposure to the hazards of mineral extraction. This low rate marked the nineteenth time a new record has been established in the 35-year history of the National Safety Competition. Although the disabling injury-severity rate for 1959 did not enjoy the same degree of success, it still was the third lowest ever experienced.

Begun in 1925, this safety contest is conducted annually by the Federal Bureau of Mines in cooperation with THE EXPLOSIVES ENGINEER, which provides the Sentinels of Safety trophy awarded each year to the winning participant in each group.

Since its inception, the National Safety Competition has exerted a strong influence in the field of safety promotion. The statistical record of its accomplishment gives strong support to the thesis that a well-organized and well-administered safety program, combined with a common incentive, is an effective managerial tool which can be used to reduce or eliminate the number of disabling work injuries suffered by employes. These annual contests also serve to stimulate and hold the interest of all concerned—employes and management alike—in accident prevention. Because of this stimulus, participants generally achieve a more favorable safety record than other operations.

More Accident-Free Operations

Another noteworthy achievement by participants in the 1959 National Safety Competition was the establishment of a record number of operations that enjoyed the distinction of operating throughout the contest year without a disabling work injury. Of the 280 that operated without a disabling injury, the noncoal groups accounted for 265, or 95% of all disabling injury-free records posted. Of these, the quarry group totaled 184, or 66%.

The domination of the quarry group in this area is understandable upon review of the statistical record. Each year since the contest began, this group has had more participants than any other group in the competition. This, of course, is not the complete answer to the favorable showing of these participants. Their contribution was somewhat more than just a numerical volume. While they represent 47% of all participants in this competition, they also account for 66% of all the disabling injury-free records. This achievement should present an envi-

*Chief, Branch of Accident Analysis
Div. of Health and Accident Prevention
Bureau of Mines
U. S. Department of the Interior
Washington, D. C.

LOADING: Operating the 8BU loading machine at the Harwick Mine, Duquesne Light Company, located near Pittsburgh, Pennsylvania, is John Zack, operator.

SAFETY SIGN: Outside the bathhouse at the Harwick Mine this sign shows the daily safety record of the Harwick employes. The entire mine has worked since December 8, 1958, without a lost-time accident. Shown here, from left to right, are James H. Truax, superintendent of the Harwick Mine; Leyester Deporter, a member of the safety committee; Charles Bliss, chairman of the safety committee; Maurice E. Fowler, safety engineer; Frank M. Coprivinicar, mine foreman; and Hubert Window, safety committee member.

able goal for other groups of the National Safety Competition.

Number of Entrants Near Peak

Some other salient features of the 1959 National Safety Competition are: The number of participating operations—672—was only 3 below the record of 675 achieved in 1958. The geographical makeup of the 35th contest included representation from 44 states. The number of competing operations by group was: anthracite, 8 or 1.2%; bituminous-coal, 121 or 18%; metal, 58 or 8.6%; nonmetal, 51 or 7.6%; open-pit, 119 or 17.7%; and finally, quarry, 315, accounting for 46.9%. The combined disabling injury-severity rate of all participants was 4,334.659. In other words, the average number of days of disability charged per million man-hours was nearly 4,335. This rate has added significance for competing operations because it historically has been, and is, the rate by which group winners are determined. The disabling injury-severity rate for all 1959 National Safety Competition participants was the third lowest such rate on record. A lower rate, that of 4,051, was posted in 1953, and again in 1955 when a record rate of 3,872 was established.

The National Safety Competition was established to encourage the development of effective accident-prevention programs in the nation's mines and quarries and to assist management of these mineral-extractive operations in its effort to foster safety-consciousness in their employes by according national recognition to operations achieving outstanding safety records. The competition is conducted annually and participation is open to all mines and quarries in the United States. It is divided into six separate and distinct groups. Each group has been specifically designed to assure, as far as possible, comparable competition among its participants. These groups are: underground anthracite mines, underground bituminous-coal mines, underground metal mines, underground nonmetal mines, open-pit mines, and quarries.

Awards to Winners

The awards available to partici-

STAFF: Safety men of the Wauseca Mine: top row, left to right, Oscar Olson, union safety committee; R. M. Neil, safety engineer; William Goriesky, Edward Andreski, and Joe Shubat, union safety committee. Bottom row, left to right, J. H. Morrow, assistant superintendent; John Hemeleski, Lionel Owen, union safety committee; James Doyle, safety supervisor; J. D. McAuliffe, superintendent; W. A. Lundwall, captain.

pants of the competition are:

1. A bronze Sentinels of Safety trophy, which is presented annually to the participant achieving the best safety record in its competitive group.

2. A Certificate of Accomplishment in Safety is awarded to each employe and official of the winning mine or quarry in recognition of the part each played in establishing the winning record.

3. A Certificate of Achievement in Safety is awarded to all participating mines and quarries having worked 30,000 or more man-hours during the competitive year without a disabling work injury. It is also awarded to the participants whose position in the contest ranked second, third, fourth, and fifth in each group.

To become a potential winner of the Sentinels of Safety trophy, a participant must have been actively engaged in extracting minerals for at least 100 days and must have accumulated 30,000 or more man-hours of exposure to the hazards of mining or quarrying during the contest year, which begins January 1 and ends December 31. Competing mines and quarries must

PROFILE: Head frame of the Wauseca Mine of The Hanna Mining Company at Iron River, Michigan, is massed against the sky.

submit to the Federal Bureau of Mines an official report of quarterly employment data and a report of each disabling work injury—if an injury was experienced. Furthermore, all entrants must be enrolled not later than April 1 of the contest year and all fourth-quarter reports must be filed on or before February 15 of the year immediately following the close of the contest.

Application forms for enrollment in the National Safety Competition and copies of the contest rules may be obtained from the Branch of Accident Analysis, Division of Health and Accident Prevention, Bureau of Mines, U. S. Department of the Interior, Washington 25, D. C., or from any of the field offices of the Bureau of Mines.

Committee of Award

The members of the Committee of Award who selected the winners of the Sentinels of Safety trophy in 1959 were: Joseph L. Gilson, president, American Institute of Mining, Metallurgical, and Petroleum Engineers; G. Donald Kennedy, president, Portland Cement Association; Howard Pyle, president, National Safety Council; Charles Ferguson, director, Safety Division, United Mine Workers of America; Raymond E. Salvatti, president, American Mining Congress; Hugo E. Johnson, president, American Iron Ore Association; and Stephen F. Dunn, president, National Coal Association. The Bureau of Mines submitted to the Committee of Award the contest records of the five operations in each competitive group having the lowest disabling injury-severity rate during the 1959 competition. The committee then selected the winners listed below.

The Six Winners

Anthracite: Stockton Mine, Stockton, Luzerne County, Pennsylvania. Mine operated by Jeddo-Highland Coal Company.

Bituminous-Coal: Harwick Mine, Harwick, Allegheny County, Pennsylvania. Mine operated by Duquesne Light Company.

Metal: Wauseca Mine, Iron River, Iron County, Michigan. Mine operated by The Hanna Mining Company.

Nonmetallic: Clarence Center Mine, Akron, Erie County, New York. Mine operated by Bestwall Gypsum Company.

Open-Pit: Rouchleau Mine, Virginia, St. Louis County, Minnesota. Mine operated by Oliver Iron Mining Division of United States Steel Corporation.

Quarry: Port Inland Quarry, Gulliver, Schoolcraft County, Michigan. Quarry operated by Inland Lime and Stone Company Division of Inland Steel Company.

Anthracite Mines

The Stockton Mine of Jeddo-Highland Coal Company, Stockton, Luzerne County, Pennsylvania, operated a total of 57,329 man-hours without a disabling work injury during 110 days of exposure to the hazards of underground anthracite mining. The award-winning record was the first time in 18 years of participation that this mine has achieved a disabling injury-free record. The Stockton Mine, however, won the trophy in 1942, the first year of its participation in the competition. This mine was awarded a Certificate of Achievement in Safety in 1945, 1957, and 1958 for ranking in fifth, second, and third places, respectively.

The eight anthracite mines participating in the competition during 1959 had a frequency rate of 51.91 disabling injuries per million man-hours. The comparable rate for this group of mines in 1958 was 57.87, which indicates a more favorable record for 1959. The disabling injury-severity rate per million man-hours in 1959 was 11,072.663, almost three times higher than the rate of 4,520.405 established in the 1958 competition.

Bituminous-Coal Mines

Among the 121 bituminous-coal mines participating in the 1959 competition, the Harwick Mine of Duquesne Light Company, at Harwick, Allegheny County, Pennsylvania, operated 355,088 man-hours during the year without a disabling work injury to win the competition.

The Harwick Mine has participated in 30 competitions since it was first entered in 1925, and 1959 is the first year it achieved a disabling injury-free record. During the 30 years, the mine has operated for 24,857,964 man-hours with an extremely low frequency rate of 19.269 disabling work injuries per million man-hours of worktime.

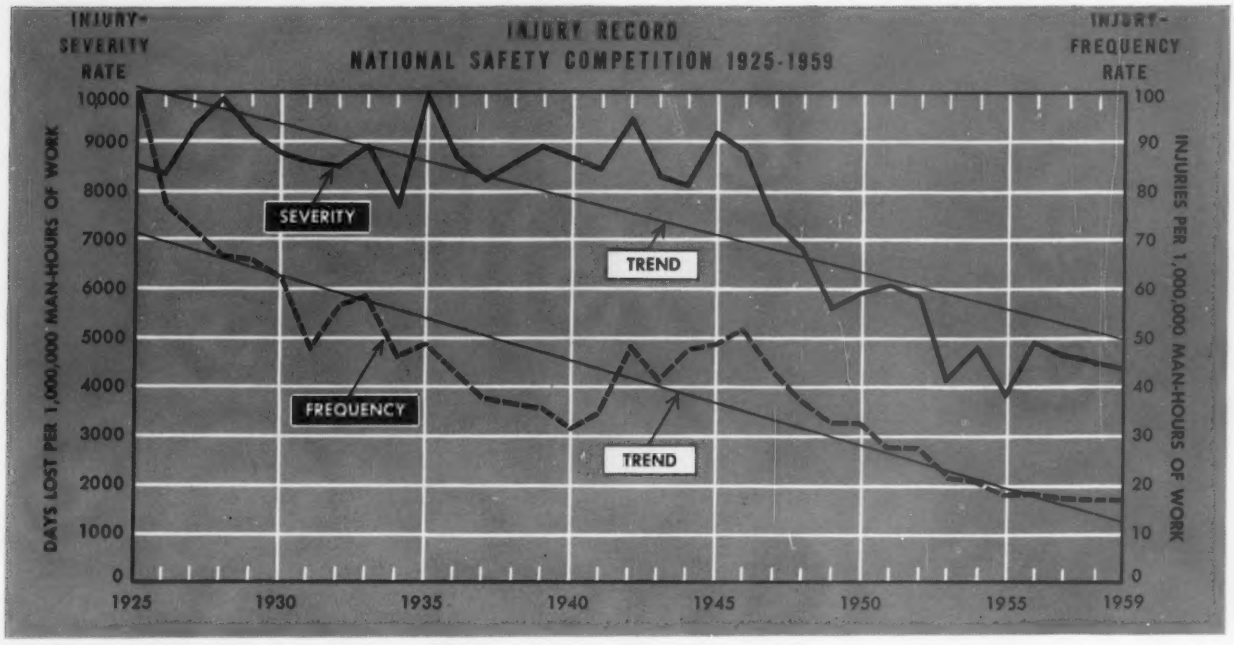
The enrollment of bituminous-coal mines in 1959 was 121. These mines worked 39,141,125 man-hours and had 917 disabling work injuries—23 fatal and 894 nonfatal. The frequency rate of 23.428 disabling work injuries per million man-hours of exposure to underground mining hazards was 7.87% lower than that of 25.318 recorded in 1958, and 42.03% lower than the overall 35-year rate of 40.416. A disabling injury-severity rate of 6,260.704 days lost per million man-hours in 1959 was not so favorable as the rate of 6,073.510 in 1958, although it was much lower than the 35-year average rate of 8,992.880 for the group as a whole.

Metal Mines

For the first time in its 17 years of participation in the National Safety Competition, the Wauseca Mine of Hanna Mining Company (The M. A. Hanna Company), Iron River, Iron County, Michigan, won the Sentinels of Safety trophy in the underground metal mines group. The winning record was 332,563 man-hours of operation without a disabling work injury.

In its history of 17 years in the competition, the Wauseca Mine has operated almost 5 million man-hours underground, recording an average disabling injury-severity rate of 6,577.529 days charged, and a frequency rate of 9.806 disabling work injuries per million man-hours.

A total of 58 underground metal mines was enrolled in 1959. As a group, they reported a disabling injury-severity rate of 6,057.435 days lost per million man-hours. This rate was an improvement over the 6,363.418 recorded in 1958. The frequency rate for 1959 was 25.505 disabling work injuries per million man-hours of exposure to hazards in underground mining and was slightly higher than that of 21.716 recorded in 1958; however, the 1959 frequency rate was well below the 35-year average rate of 34.317 for the group.



SALIENT FEATURES OF THE NATIONAL SAFETY COMPETITION

1959

Type of mine	*Number of mines*	*Man-hours*	*Fatal injuries*	*Nonfatal injuries*	*Total injuries*	*Days of Disability*	*Frequency rate*	*Severity rate*
Anthracite	8	2,600,639	4	131	135	28,796	51.910	11,072.663
Bituminous-coal	121	39,141,125	23	894	917	245,051	23.428	6,260.704
Metal	58	17,525,736	13	434	447	106,161	25.505	6,057.435
Nonmetallic mineral	51	8,115,313	3	154	157	25,619	19.346	3,156.871
Total	238	67,382,813	43	1,613	1,656	405,627	24.576	6,018.256
Open-pit	119	26,747,999	4	224	228	44,941	8.524	1,680.163
Quarries	315	26,734,062	8	319	327	73,340	12.232	2,743.317
Grand total	672	120,864,874	55	2,156	2,211	523,908	18.293	4,334.659

THE 35-YEAR HISTORY OF THE NATIONAL SAFETY COMPETITION

1925-1959

(CUMULATIVE FIGURES)

Type of mine	*Man-hours*	*Fatal injuries*	*Nonfatal injuries*	*Total injuries*	*Days of Disability*	*Avg. Frequency rate*	*Avg. Severity rate*
Anthracite	671,124,597	788	58,363	59,151	7,006,858	88.137	10,440.473
Bituminous-coal	1,617,917,142	1,535	63,855	65,390	14,549,734	40.416	8,992.880
Metal	642,800,465	489	21,570	22,059	4,292,320	34.317	6,677.531
Nonmetallic mineral	178,176,273	100	4,650	4,750	892,260	26.659	5,007.737
Total	3,110,018,477	2,912	148,438	151,350	26,741,172	48.665	8,598.397
Open-pit	456,310,950	119	6,500	6,619	1,169,917	14.505	2,563.859
Quarries	627,552,394	282	10,996	11,278	2,574,088	17.971	4,101.790
Grand total	4,193,881,821	3,313	165,934	169,247	30,485,177	40.356	7,268.964

GYPSUM WINNERS: The miners of the Clarence Center Mine of the Bestwall Gypsum Company, Akron, New York, worked through 1959 without a lost-time injury to win the top award in the nommetallic division.

Nonmetallic-Mineral Mines

The Sentinels of Safety trophy for the best safety record in the underground nonmetallic-mines group will be awarded to the Clarence Center Mine of Bestwall Gypsum Company, Akron, Erie County, New York. This mine worked 265,192 man-hours in 1959 without a disabling work injury. This was achieved after only two years of participation. It was first enrolled in the National Safety Competition in 1958 when it was awarded third place for operating 213,004 man-hours without a disabling work injury. As a result, is was awarded a Certificate of Achievement in Safety.

The 51 nonmetallic-mineral mines participating in 1959 operated more than 8 million man-hours. The disabling injury-severity rate was 3,156.871 days lost per million man-hours of exposure. This is an improvement of 44% over the rate of 4,534.459 in 1958, and it is 58% below the 35-year average disabling injury-severity rate of 5,007.737. The 1959 disabling injury-frequency rate of 19.346 for this group was more favorable than the 23.356 recorded in the previous year. Both rates were somewhat better than the corresponding average rates for the 35-year period.

GYPSUM: Loading cars at the Bestwall Gypsum's Akron, New York, mine operations are Marvin Alexander and John Smith behind the loader.

Open-Pit Mines

The Rouchleau Mine of Oliver Iron Mining Division, United States Steel Corporation, Virginia, St. Louis County, Minnesota, won the Sentinels of Safety trophy for having the best safety record among the open-pit mines participating in the 1959 National Safety Competition. This open-pit iron-ore mine worked 627,409 man-hours during 1959 without a disabling work injury.

During its two years of participation in the contest, the Rouchleau Mine worked more than 1½ million man-hours with a disabling injury-severity rate of 198.705 and a disabling injury-frequency rate of 1.325 per million man-hours. This is the first year the Rouchleau Mine has been listed among the winners. The record of the Rouchleau Mine is an enviable one when compared with the record of the entire open-pit group for 1959,

which is 8.524 disabling work injuries per million man-hours and a disabling injury-severity rate of 1,680.163 days of disability per million man-hours.

The injury experience of the 119 participating open-pit mines in the 1959 National Safety Competition compares favorably with the 35-year average for the group, that of 14.505 disabling work injuries per million man-hours and a disabling injury-severity rate of 2,563.859 days of disability per million man-hours.

Quarries

The Port Inland Quarry of Inland Lime and Stone Company Division of Inland Steel Company, Gulliver, Schoolcraft County, Michigan, won top honors in the quarry group and will be awarded the Sentinels of Safety trophy. The quarry operated 451,317 man-hours during 1959 without a disabling work injury. The Port Inland Quarry has participated in the National Safety Competition for 27 successive years and won the Senti-

MINE AND DISTRICT SAFETY: Operating and safety personnel of Oliver's Eastern District and of the Sentinels of Safety-winning Rouchleau Mine. Front row, left to right, Herbert Hewett, safety engineer; David Hartley, mine superintendent; A. C. MacInnis, general foreman; John Chisholm, district general superintendent; B. W. Zulsdorf, district safety supervisor. Second row, left to right, Wallace Salmela, locomotive fireman; Robert Waisa, locomotive brakeman; and Harold Nelson, locomotive engineer.

SAFETY MAINTENANCE: Track gang making a railroad track safe in the Sauntry area of the Rouchleau Mine group with a train of 40-yd. side-dump cars being loaded in the background.

GYPSUM WINNERS: The miners of the Clarence Center Mine of the Bestwall Gypsum Company, Akron, New York, worked through 1959 without a lost-time injury to win the top award in the nommetallic division.

Nonmetallic-Mineral Mines

The Sentinels of Safety trophy for the best safety record in the underground nonmetallic-mines group will be awarded to the Clarence Center Mine of Bestwall Gypsum Company, Akron, Erie County, New York. This mine worked 265,192 man-hours in 1959 without a disabling work injury. This was achieved after only two years of participation. It was first enrolled in the National Safety Competition in 1958 when it was awarded third place for operating 213,004 man-hours without a disabling work injury. As a result, is was awarded a Certificate of Achievement in Safety.

The 51 nonmetallic-mineral mines participating in 1959 operated more than 8 million man-hours. The disabling injury-severity rate was 3,156.871 days lost per million man-hours of exposure. This is an improvement of 44% over the rate of 4,534.459 in 1958, and it is 58% below the 35-year average disabling injury-severity rate of 5,007.737. The 1959 disabling injury-frequency rate of 19.346 for this group was more favorable than the 23.356 recorded in the previous year. Both rates were somewhat better than the corresponding average rates for the 35-year period.

GYPSUM: Loading cars at the Bestwall Gypsum's Akron, New York, mine operations are Marvin Alexander and John Smith behind the loader.

Open-Pit Mines

The Rouchleau Mine of Oliver Iron Mining Division, United States Steel Corporation, Virginia, St. Louis County, Minnesota, won the Sentinels of Safety trophy for having the best safety record among the open-pit mines participating in the 1959 National Safety Competition. This open-pit iron-ore mine worked 627,409 man-hours during 1959 without a disabling work injury.

During its two years of participation in the contest, the Rouchleau Mine worked more than 1½ million man-hours with a disabling injury-severity rate of 198.705 and a disabling injury-frequency rate of 1.325 per million man-hours. This is the first year the Rouchleau Mine has been listed among the winners. The record of the Rouchleau Mine is an enviable one when compared with the record of the entire open-pit group for 1959,

which is 8.524 disabling work injuries per million man-hours and a disabling injury-severity rate of 1,680.163 days of disability per million man-hours.

The injury experience of the 119 participating open-pit mines in the 1959 National Safety Competition compares favorably with the 35-year average for the group, that of 14.505 disabling work injuries per million man-hours and a disabling injury-severity rate of 2,563.859 days of disability per million man-hours.

Quarries

The Port Inland Quarry of Inland Lime and Stone Company Division of Inland Steel Company, Gulliver, Schoolcraft County, Michigan, won top honors in the quarry group and will be awarded the Sentinels of Safety trophy. The quarry operated 451,317 man-hours during 1959 without a disabling work injury. The Port Inland Quarry has participated in the National Safety Competition for 27 successive years and won the Senti-

MINE AND DISTRICT SAFETY: Operating and safety personnel of Oliver's Eastern District and of the Sentinels of Safety-winning Rouchleau Mine. Front row, left to right, Herbert Hewett, safety engineer; David Hartley, mine superintendent; A. C. MacInnis, general foreman; John Chisholm, district general superintendent; B. W. Zulsdorf, district safety supervisor. Second row, left to right, Wallace Salmela, locomotive fireman; Robert Waisa, locomotive brakeman; and Harold Nelson, locomotive engineer.

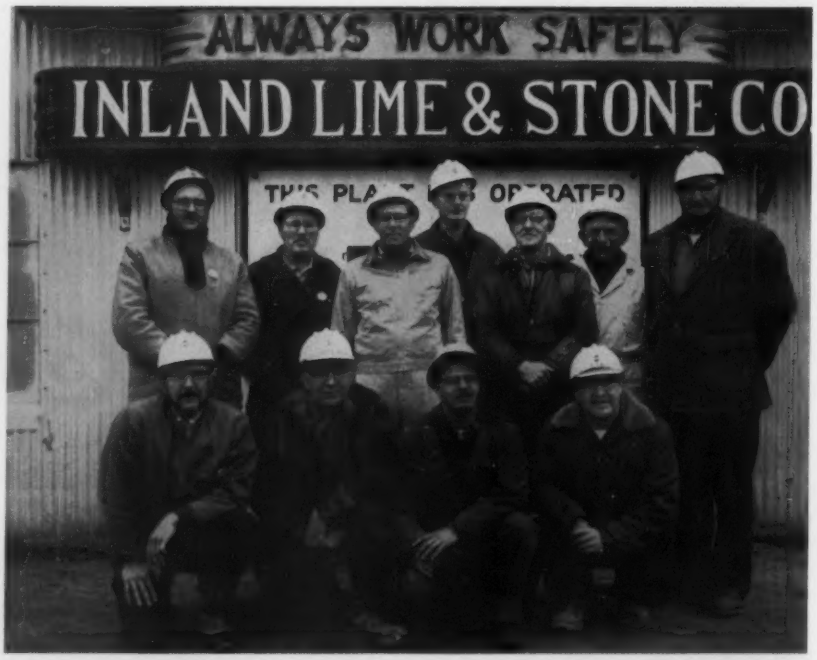
SAFETY MAINTENANCE: Track gang making a railroad track safe in the Sauntry area of the Rouchleau Mine group with a train of 40-yd. side-dump cars being loaded in the background.

AERIAL: Inland's limestone quarry at Gulliver, Michigan, as seen from the air.

nels of Safety trophy in 1938, 1939, 1951, and 1959. In addition, it won honorable mention in 1933 and 1934 for operating without a disabling work injury. During the 27-year period, the quarry operated almost 16 million man-hours with the low disabling injury-frequency rate of 9.192 and the low disabling injury-severity rate of 3,079.168 per million man-hours of exposure to the hazards of quarrying.

Compared with the average rates established by its group for the 35-year history of the competition—17.971 disabling injuries per million man-hours and 4,101.790 days lost per million man-hours—this is an excellent record of which employes and management of the Port Inland Quarry may justifiably be proud.

The 315 quarries enrolled in the 1959 competition (the second highest enrollment in 35 years) worked almost 27 million man-hours with a disabling injury-severity rate of 2,743.317 days lost per million man-hours of work and a frequency rate of 12.232 disabling work injuries per million man-hours of operation.



COMMITTEEMEN: Supervisory and safety men of the Port Inland Quarry are, left to right, standing, Elton Sample, safety committeeman; Franklyn Burgess, general quarry foreman; George Backman, general mill foreman; Bruce McKilligan, assistant chief electrician; Melville Kimmel, chief electrician; Joseph Cherneski, assistant general mill foreman; Archie Carpenter, assistant general quarry foreman. Kneeling, A. J. Cayia, Jr., superintendent; D. Ronald Gunderman, assistant master mechanic; Harold Carlson, local union president and safety committeeman; and Daniel Harrington, master mechanic.

Awards of Certificates of Achievement In Safety—1959

Rules of the competition provide for the award of Certificates of Achievement in Safety to each mine or quarry, other than the trophy winners, whose position in the contest ranked second, third, fourth, and fifth in its respective group. The mines and quarries are listed below, together with the man-hours each amassed during the competitive year.

Certificates are also awarded each disabling injury-free mine or quarry that worked 30,000 or more man-hours during the 12 consecutive months of each contest.

ANTHRACITE MINES

Loree 2, 4, and 5 Mines, Larksville, Luzerne County, Pennsylvania, operated by The Hudson Coal Company, 755,695 man-hours with 43 disabling work injuries causing 1,439 days of disability. Disabling injury-severity rate was 1,904.207 per million man-hours.

Boston Mine, Larksville, Luzerne County, Pennsylvania, operated by The Hudson Coal Company, 73,878 man-hours with 4 disabling work injuries causing 331 days of disability. Disabling injury-severity rate was 4,480.360 per million man-hours.

Eddy Creek Colliery, Olyphant, Lackawanna County, Pennsylvania, operated by The Hudson Coal Company, 702,851 man-hours with 28 disabling work injuries causing 7,150 days of disability. Disabling injury-severity rate was 10,172.853 per million man-hours.

Loree No. 3 Mine, Larksville, Luzerne County, Pennsylvania, operated by The Hudson Coal Company, 519,780 man-hours with 31 disabling work injuries causing 7,145 days of disability. Disabling injury-severity rate was 13,746.200 per million man-hours.

BITUMINOUS-COAL MINES

Hunter Mine, Coal City, Raleigh County, West Virginia, operated by Republic Steel Corporation, 233,938 man-hours without a disabling work injury.

Labuco Mines, Labuco, Jefferson County, Alabama, operated by Alabama By-Products Corporation, 233,464 man-hours without a disabling work injury.

Bell Creek Mine, Cedar Grove, Kanawha County, West Virginia, operated by Union Carbide Metals Company, Division of Union Carbide Corporation, 124,840 man-hours without a disabling work injury.

Bowman Mine, Tunnelton, Westmoreland County, Pennsylvania, operated by Bowman Coal Company, 94,625 man-hours without a disabling work injury.

METAL MINES

Edwards Mine, Bessemer, Jefferson County, Alabama, operated by Republic Steel Corporation, 284,345 man-hours without a disabling work injury.

Iron Mountain Mine, Iron Mountain, St. Francois County, Missouri, operated by Ozark Ore Company, 263,070 man-hours without a disabling work injury.

Wenonah No. 7 Mine, Bessemer, Jefferson County, Alabama, operated by Tennessee Coal & Iron Division, U. S. Steel Corporation, 206,083 man-hours without a disabling work injury.

Wenonah No. 8 Mine, Bessemer, Jefferson County, Alabama, operated by Tennessee Coal & Iron Division, U. S. Steel Corporation, 204,279 man-hours without a disabling work injury.

NONMETALLIC MINES

Grand Rapids Mine, Grand Rapids, Kent County, Michigan, operated by Bestwall Gypsum Company, 260,295 man-hours without a disabling work injury.

Bellefonte Mine, Bellefonte, Centre County, Pennsylvania, operated by National Gypsum Company, 212,218 man-hours without a disabling work injury.

Kimballton Mine, Kimballton, Giles County, Virginia, operated by Standard Lime & Cement Company, 176,581 man-hours without a disabling work injury.

Ironton Mine, Ironton, Lawrence County, Ohio, operated by Alpha Portland Cement Company, 142,505 man-hours without a disabling work injury.

OPEN-PIT MINES

Orange Park Mine, Lakeland, Polk County, Florida, operated by American Cyanamid Company, 423,561 man-hours without a disabling work injury.

Lone Star Mines, Lone Star, Morris County, Texas, operated by Lone Star Steel Company, 330,007 man-hours without a disabling work injury.

Danube Mine, Bovey, Itasca County, Minnesota, operated by Balkan Mining Company (Pickands Mather and Company), 270,367 man-hours without a disabling work injury.

Pauway No. 4 Mine, Bartow, Polk County, Florida, operated by W. R. Grace & Company, Davison Chemical Division, Florida Phosphate Division, 239,677 man-hours without a disabling work injury.

QUARRIES

Lowellville Quarry, Lowellville, Mahoning County, Ohio, operated by The Carbon Limestone Company, 366,988 man-hours without a disabling work injury.

Clinton Point Quarry, New Hamburg, Dutchess County, New York, operated by New York Trap Rock Corporation, 340,112 man-hours without a disabling work injury.

Acme Quarry, Quanah, Hardeman County, Texas, operated by Bestwall Gypsum Company, 330,292 man-hours without a disabling work injury.

Stoneport Quarry, Alpena, Alpena County, Michigan, operated by Presque Isle Corporation, 314,348 man-hours without a disabling work injury.

New York Trap Rock Quarry Wins NCSA And Explosives Engineer Plaques

Severity rate in 1958 jumps to highest since 1947; frequeney rate was highest since 1950

OVER 2,000 people attended the 43rd annual convention of the National Crushed Stone Association held at the Conrad Hilton Hotel, Chicago, Illinois. The luncheon on the opening day was the occasion for the presentation of the NCSA safety awards to 33 quarries with perfect safety records during the year 1958.

Paul Jones, director of information for the National Safety Council, addressed the gathering.

The safety contest of the association is designed to stimulate crushed stone producers to take greater interest in accident-prevention programs through the recognition of plants with no disabling injuries. Conducted by the United States Bureau of Mines of the Department of the Interior, the contest awards are based on statistics obtained from the quarries and compiled by the Bureau.

For the first time, the contest was

SMILING SUPERS: George White, superintendent of Clinton Point Quarry (right), first-place winner in Group I, received the award on behalf of the employes who worked so hard and so safely to win it. John Jorgenson, superintendent of the Tomkins Cove Quarry, also operated by New York Trap Rock Corporation, stands at left holding the National Crushed Stone Association Safety Contest Award plaque. The Tomkins Cove Quarry placed third in Group I. The Explosives Engineer trophy in the center also went to the Clinton Point Quarry.

divided into five man-hour groups to provide greater incentive for the smaller operations. The entrants were grouped as follows: Group I, plants working 200,000 man-hours or more; Group II, 100,000 to 200,000 hours; Group III, 50,000 to 100,000 hours; Group IV, 30,000 to 50,000 hours; and Group V, 30,000 hours or less.

Group Winners

The winner in the largest group was the Clinton Point Quarry, New Hamburg, New York, of the New York Trap Rock Corporation. This quarry also won THE EXPLOSIVES ENGINEER bronze plaque as the quarry with the greatest number of man-hours which had operated throughout the contest year with the best safety record.

In the future, THE EXPLOSIVES ENGINEER plaque will be awarded on a different basis, and will go to the quarry operated the greatest number of consecutive days without a disabling work injury, regardless of the contest year, and which has throughout the period complied with the rules of the association contest. The first award of the plaque on the new basis will be made at the NCSA convention to be held early in 1961 for the period ending December 31, 1959.

The winning quarry in Group II was the North Branford No. 7 Quarry, North Branford, New Haven County, Connecticut, operated by the New Haven Trap Rock Company with 144,331 man-hours without a disabling work injury. R. D. Brewer is superintendent of the quarry.

Woodleaf Quarry, Woodleaf, Rowan County, North Carolina, won the Group III award with 95,203 man-hours. It is operated by Superior Stone Company. Superintendent of the quarry is H. C. Burgess.

The Group IV winner was the Hickory Quarry, Hickory, Catawba County, North Carolina, operated by Superior Stone Company, with 47,718 man-hours. Superintendent of the quarry is John Long.

The White Haven Quarry, White Haven, Luzerne County, Pennsylvania, operated by General Crushed Stone Company, won the Group V award with a perfect safety record and 28,222 man-hours. Burr Shaver is superintendent of the quarry.

The New Awards

The plant with the highest number of man-hours without a disabling work injury in each group receives a wooden plaque with a bar inscribed "Group Winner," the number of man-hours worked, and the year in which the record was made. For each additional year up to five without a disabling work injury, the plant will receive a bronze bar similarly incribed; from five to ten consecutive years, a silver bar; and for ten or more consecutive years, a gold bar. Each employe of these operations receives an individual certificate inscribed with his name.

Eight Fatalities

The experience of all the crushed stone quarries entered in the 1958 contest was worse than it has been in any year of the contest since 1947. Eight fatalities raised the severity rate to 6,360.301 days lost per million man-hours of exposure, compared with 1,097.040 days lost in 1957. In 1947 the quarries suffered ten fatalities, and the severity rate was 8,902 days lost per million man-hours of exposure.

The frequency rate for 1958 also rose; the 21.516 injuries per million man-hours of exposure compared with 18.458 injuries in 1957, and was the highest since 1950.

Classification of Injuries

Injuries in 1958 were classified as follows: falls and slides of rock resulted in two fatalities; haulage, three fatalities; falling objects, one fatality; machinery, one fatality; and other causes, one fatality; handling materials, one permanent partial injury; drilling, one permanent partial injury; machinery, three permanent partial injuries. All classifications contributed to the total of 168 temporary disability injuries and 181 total injuries.

The accompanying table shows the days of disability by classification of injuries in the 1958 contest.

Thirty-three operations, of which 28 were quarries and five underground mines, achieved perfect safety records in 1958. Each of these operations receives the NCSA award and each employe receives an individual certificate inscribed with his name, the year, and the plant and company name. The 33 plants with injury-free records for the year worked 2,415,566 man-hours, which was 29% of the total hours of the 97 plants enrolled in the contest.

The distribution of the contest entrants by states was: New York, 18 operations; Pennsylvania, 10; Kentucky and Ohio, 9 each; North Carolina, 8; Missouri, 6; Virginia, 5; Illinois and Wisconsin, 4 each; Connecticut and Iowa, 3 each; Georgia, Maryland, Massachusetts, Michigan, Tennessee, and Texas, 2 each; and Alabama, Indiana, Montana, New Jersey, Oklahoma, and South Dakota, 1 each.

Classification	Fatal	Permanent		Temporary	Total Days of Disability
		Total	Partial		
Falls and slides of rock	12,000	—	—	334	12,334
Handling materials	—	—	60	485	545
Hand tools	—	—	—	399	399
Explosives	—	—	—	25	25
Haulage	18,000	—	—	499	18,499
Falls of persons	—	—	—	710	710
Bumping against objects	—	—	—	321	321
Falling objects	6,000	—	—	198	6,198
Flying objects	—	—	—	101	101
Electricity	—	—	—	136	136
Drilling	—	—	100	177	277
Machinery	6,000	—	1,135	620	7,755
Stepping on objects	—	—	—	111	111
Burns	—	—	—	77	77
Other causes	6,000	—	—	17	6,017
	48,000	—	1,295	4,210	53,505

THE CUT: The right-of-way for Interstate Route 78 passes through one of the highest points in New Jersey.

Jugtown Mountain Cut

New Jersey's largest highway cut, one-half mile long, 150 ft. wide, with a maximum depth of 120 ft., nears completion

DON GOODMAN*

NEXT winter, when Interstate Route 78 in northern New Jersey is completed and open to the public, motorists and truckers rolling along this superhighway in the vicinity of Jugtown Mountain will little remember the troubles encountered in previous winters when they were frequently delayed because ice and snow made the hill difficult to traverse. According to local tradition, the name Jugtown Mountain was inspired by the number of illicit stills supposedly operated in these hills.

Interstate Route 78, the proposed freeway that starts at the Holland Tunnel in New York City, runs through many states until it reaches its western terminus at Cleveland, Ohio. In its journey west, the route passes through several states with varied terrain, but probably nowhere along its right-of-way does it encounter so much rugged roadbuilding conditions as in Hunterdon County in New Jersey, where the road cuts through the Muscanetcong Mountains.

Here, at a location a few miles west of Clinton, known locally as Jugtown Mountain, the highway cuts through a rise that is over 800 ft. high and one of the highest rises in that area, if not in all of New Jersey. The Jugtown Mountain cut is only part of the overall contract awarded to Yonkers Contracting Company of Yonkers, New York, specialists in rock and dirt ex-

*Hercules Powder Company
380 Madison Avenue
New York 17, New York

cavation, whose headquarters are at 969 Midland Avenue. The entire contract held by Yonkers calls for the excavation and grading of 4.8 miles of roadbed and involves the removal of 3,698,039 cu. yd. of unclassified material. Much of this material is composed of metamorphic crystalline rock. To meet Federal specifications as part of the Federal Defense Highway system, a maximum of 4% grade must be maintained.

This is the largest single grading contract ever awarded by the New Jersey Highway Department. As part of the Federal Defense Highway system, 90% of the cost of building the freeway will be borne by the Federal Government. Although the road will cross northern New Jersey for a total distance of 68 miles, only 4.8 miles are included in the Yonkers contract, whose bid was $6,379,960.60. The paving is to be let by New Jersey Highway Department under a special contract.

Specifications

The general specifications for Interstate 78 are similar to accepted free-

TOUGH ROCK: The basic rock formation in the Jugtown area is syenitic gneiss granite and quartzite, and is hard to drill. About 70% of the material excavated is rock.

DRILLING FOR A BLAST: A normal blast consists of 4-in.-diameter holes, 20 ft. deep, laid out on a 10 by 10-ft. grid extending across the width of the cut. The size of a blast depends upon the number of holes ready when the shovels need rock.

LOADING: A 20-ft.-deep 4-in.-diameter hole usually was loaded with 130 lb. of explosives. This resulted in a powder factor of 0.75 lb. of explosives per cu. yd. of material.

way building practices. The entire highway will be of the limited access type of dual lanes with no crossroads, cross-over facilities, or traffic signals. The road will have a maximum grade of 4%, which will be maintained by blasting cuts through the hills and using the blasted rock as fill material at the low points. The width of each of the dual pavements will be 25 ft. which will be separated by an 84-ft. landscaped center strip. In addition to the excavating and grading, the Yonkers contract also calls for the building of two box culverts and three bridges to carry traffic on three intersecting roads over the freeway.

Yonkers Contracting Company started actual construction work on January 17, 1959, with A. E. (Red) Ellison as project manager. Work has progressed so smoothly that, working only one shift, the contract is approximately 85% completed and six months ahead of the time scheduled for finishing. Anticipated date for the comple-

A BLAST: The blasting procedure followed throughout the job produced well-fragmented rock properly placed for easy handling by the shovels and hauling equipment.

NO WAITING: The work at the face was a model of efficiency. Two Bucyrus-Erie 88-B shovels equipped with 5-cu. yd. dippers made sure there was no delay in loading the waiting trucks.

tion of the excavating and grading is early in July of this year.

One of the reasons for the extremely good progress on this job, despite a fairly severe winter, is not only the great care paid to the selection of equipment and its proper maintenance and repair, but also to the well-kept haul roads which permit the heavy-duty haulers to consistently move at a better than average pace. Haul roads between the shovel working area and the fill sections are constantly being graded and sprinkled to eliminate delay in getting to and from these areas.

Drilling Equipment

The basic rock formation encountered in the Jugtown area, and about 70% of the material excavated, is rock, syenitic gneiss granite, and quartzite, which has a hard crystalline structure. This type of rock is extremely hard to drill and blast and, because of its very abrasive character, plays havoc with the shovels and haulage equipment.

To bring the Jugtown Mountain down to grade required making a cut 120 ft. deep. To obtain this depth the rock is blasted out in six 20-ft. benches. Much of the drilling in the cut is done by the recently introduced Ingersoll-Rand Crawlmaster, Model E-525, of which there are seven on the job. These drills are augmented by three Model D-45 Ingersoll-Rand Crawl-IR and a Joy TDM-550 Challenger. The compressed air that powers these drills is supplied by 12 Ingersoll-Rand compressors, 11 Model 600 Gyro-Flo's, and one 900 Gyro-Flo. A battery consisting of the 900 and five of the 600 compressors is hooked into a 6-in.-diameter Naylor pipe tapped by the large drills for their air requirements. The remainder of the compressors powers the individual Crawl-IR, which are used for making 3-in. holes in difficult locations and along the sides of the slopes.

Gardner-Denver hex. carburized 1⅞-in. by 20-ft. and 1¾-in. by 12-ft. drill steel fitted with Brunner & Lay 3- and 4-in. Rok Bits with carbide inserts were used in the drilling operations. Penetration rates on all size holes were average for the material in this area.

The Brunner & Lay carbide insert bits held up very well in the tough, abrasive rock. The bits were resharpened at regular intervals to maintain good drilling production and increase the life of the bit.

Blasting

Blasting techniques used in the Jugtown cut are based on standard procedures for this type of rock work, with certain innovations developed by the Yonkers engineers. Extreme care is exercised in the planning and execution of this very important phase of the operations so that every blast will meet the requirements for well-broken rock. The advantages gained in the ease and speed of handling well-fragmented rock, plus the reduction of wear and tear on equipment, more than offset the cost of the slight additional explosives used. Specifically, there is less secondary blasting, which eliminates shovel downtime; the rock is more easily and more rapidly loaded by the shovels; more cubic yards can be loaded into the haul trucks; and the rock compacts better in the fill area.

A typical blast pattern consists of 4-in.-diameter holes laid out on a 10 by 10-ft. grid running across the entire width of the cut, which is about 150 ft. These holes are 20 ft. deep. The number of rows of holes in a blast depends upon the number drilled, loaded, and ready to fire when the shovels are in need of rock. The normal blast will consist of 21 holes in three rows. An average of three blasts will be made in a 10-hour day. The 3-in.-diameter holes were spaced on an 8 by 8-ft. grid and were 24 ft. deep.

The loading varied, depending upon the condition of the rock and the amount of water in the hole. For a reasonably dry 4-in.-diameter 20-ft. hole, the explosive charge could consist of 15 lb. of extra dynamite 40% placed in the bottom. Upon this was placed 15 lb. of Hercol® 2, then 100 lb. of Dynatex®. The remainder of the hole was then filled with 8 ft. of stemming consisting of rock dust and drill fines. M.S. delays, with 24-ft. copper leg wires, periods 1 to 12, located in the bottom of the holes, were connected in series-in-parallel and initiated by a 50-cap blasting machine. With a powder factor of 0.75 lb. of explosives per cu. yd. of material, the fragmentation was excellent and very little secondary blasting was needed.

Seismographs

Only one major blasting problem was encountered in the Jugtown area, and proper precautions were taken to keep this problem under control. A Lehigh Valley Railroad tunnel passes through the mountain 180 ft. below the bottom level of the cut. Extreme care is taken in the placement and amount of explosives used in every blast. Seismographs are placed in the tunnel and complete seismograph records are made of every blast. This care has paid off, for there have been no excess vibrations and no apparent damage to the tunnel.

Material Removal

Working in the blasted area, almost without interruption, are three Northwest 80-D shovels with 2½-cu. yd. dippers and two Bucyrus-Erie 88-B shovels with 5-cu. yd. dippers. The 88-B's normally use a 4-cu. yd. dipper, but

GOOD FRAGMENTATION: That Yonkers' blasting technique, designed to produce easily handled rock, is a success is proved by this on-the-job photograph of a dipper loaded with well-fragmented material.

these were modified according to Yonkers' requirements for the larger dippers. The modified shovels are powered by Cummins 260-hp. diesels.

With all five shovels and seven Euclid S-18 scrapers running at peak production, from 20,000 to 22,000 cu. yd. of material a day could be handled. During the winter months, an average of 10,000 cu. yd. a day was maintained. This excellent production was possible because two shovels were usually at a loading face, and the big haul trucks were ready and waiting for the shovel as soon as a loaded vehicle departed for the fill area. The average load was 19 cu. yd.

A fleet of 22-cu. yd. trucks, consisting of 15 Model 95 International Payloaders augmented by 12 Model 146 TD Euclids and 10 Euclid 137 belly dumps, carry the blasted material at high speed to the fill area, where a spotter directs the dumping so that the proper blend of rock and dirt is used in making the 3-ft.-thick lifts. The Payloaders are powered by 335-hp. Cummins diesels, while the Euclids are equipped with General Motors diesels. The dump material is spread into place by two TD-24 dozers.

The average time for a truck to make the trip from the shovel to the dumping ground, unload, and return to the shovel averages about 12 minutes. Hauls range between 1,500 and 5,000 ft., and the loaded trucks haul downhill and return uphill empty.

Maintenance

Yonkers' plan for keeping equipment active on the job is based on preventive maintenance, spotting potential trouble and making adjustments or repairs before a serious breakdown can occur. Ten experienced men—six mechanics and four welders—under the supervision of Master Mechanic Charles Pantano, are constantly checking and lubricating equipment and taking immediate action on any item requiring attention. A fully equipped mechanical shop located on the job site is capable of doing any major repair or overhaul work on any equipment used on the job.

Key Personnel

The president of the progressive Yonkers Contracting Company, Inc., is Edward J. Petrillo, who has been in the construction industry the major portion of his life. Art Cipolla is chief engineer. Both of these men make their headquarters at the firm's Yonkers, New York, address. Some of the outstanding jobs done by Yonkers are sections of the Maine Turnpike extension, McGuire Air Force Base, New York Thruway, and the New England Thruway. The firm is currently working on Route 278 at Bound Brook, New Jersey.

On the Jugtown project, the following men keep the job progressing at a more than satisfactory pace: A. E. Ellison, project manager; Floyd Hilton, project superintendent; Al Pottle, project engineer; Len Nevens, assistant project engineer; Bill Colvard, rock superintendent; Stan Deerstein, blasting foreman; and Charles Pantano, master mechanic. George Bishara is office manager and purchasing agent for Yonkers Contracting.

HAUL ROAD: Smooth and well-maintained haul roads as shown on the right of this photo have enabled Yonkers to keep a speedy and uninterrupted flow of rock to the fill areas.

Quarrying Limestone in the Hudson Quarry of Universal Atlas

Steeped in historic interest, U. S. Steel Division's quarry in Columbia County, New York, is a model of efficiency in planning and operating techniques

L. J. PAULY*

THE New York State operations of the Universal Atlas Cement Division of the United States Steel Corporation are centered on the outskirts of the historic city of Hudson in Columbia County, about 100 miles north of New York City. The surrounding country is rich in historic interest, having been the scene of many battles and skirmishes during wars between the early settlers and the Indians, and, later, during the War for Independence.

Despite the fact that Hudson is the third oldest city in New York and the state's first city to be chartered after the signing of the Declaration of Independence, this area is widely known as the "Land of Rip van Winkle" for Washington Irving's legendary charactor who, feeling tired, lay down for a short nap and awoke 20 years later.

Unlike Rip van Winkle, the Hudson Quarry has been wide awake, and an active stone producer under the management of several different companies since the late 1800's. Records show that, while operating under the name of Jones Quarry Company, much of the stone for the foundations of the Brooklyn Bridge came from this quarry. Since this famous bridge was opened to the public in 1883, one can see that Hudson has been a producer of stone for well over 75 years.

The manufacture of cement and the use of the quarry for such purpose at Hudson began in 1903 by the Hudson Portland Cement Company's plant. In 1909, the facilities were purchased by the Atlas Portland Cement Company and operated by its subsidiary, the New York and New England Cement and Lime Company. In 1930, the assets of the Atlas organization were joined with those of the Universal Portland Cement Company, then a subsidiary of United States Steel Corporation. The name of the new subsidiary thus

DRILLING: The 6¼-in. holes for all primary blasts are made by this Joy Middleweight Champion. Two old-type churn drills were replaced when this modern equipment went into use.

*Hercules Powder Company
New York 17, New York

became Universal Atlas Cement Company which, in 1958, became a division of U. S. Steel. Thus, from 1930 until the present, the Hudson facilities have been operated by Universal Atlas.

Quarry Area

The quarry comprises approximately 121 acres, with present operations confined to three widely separated locations. Two areas are in the quarry proper, one on the north face and the other on the south face, each extending 1,000 ft. in a semicircular shape. The face ranges from a low of approximately 25 ft. to a high of 70 ft. The third working area consists of a ramp development which will create a new quarry face. The ramp is 60 ft. wide and 700 ft. long, and is being developed on a 6% grade. The new working level, which will be developed by this ramp, will be 40 ft. below the present working level.

The geological formations found at Hudson are unusual in that the rock and shale include all chemical ingredients necessary for the various types of cement manufactured by Atlas at this plant.

The lime formation found in the Hudson Quarry comprises three distinct strata of stone, sloping from west to east. At the west side of the quarry there is a layer of New Scotland stone having an average thickness of 70 to 75 ft. Lying on top of this stratum and running down to the center of the quarry to floor level is the high-lime-content seam of Becraft stone averaging 40 to 50 ft. in thickness. In the east section, a stratum of Port Ewen stone 23 to 30 ft. in thickness (overlying the Becraft) starts in the center of the quarry and slopes eastward to floor level.

All three formations are a hard, tough type of rock, and have long presented a problem of relatively poor fragmentation in primary blasting. Considerable blocky pieces are usually produced because of the numerous clay seams that exist throughout the working areas.

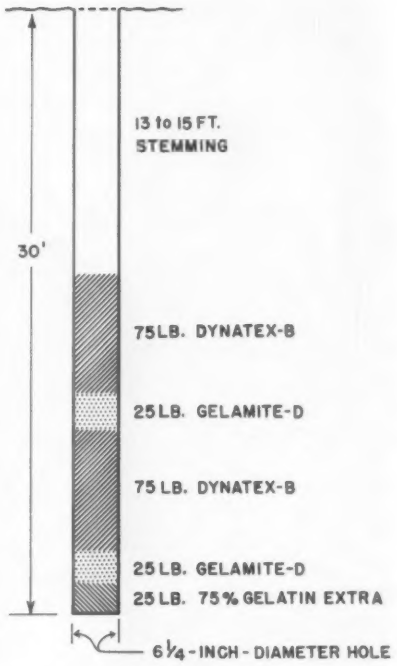


FIGURE 1: Loading diagram for a typical 6¼-in.-diameter hole. This charge resulted in well-fragmented, easily handled rock.

LOADING: A recent primary blast consisted of 13 holes, each 6¼ in. in diameter. These varied from 21 to 34 ft. in depth. The 30-ft. holes contained 225 lb. of explosives.

The thin layer of overburden, which consists primarily of clay, is removed by a D-7 Caterpillar bulldozer and pushed downhill from the area to be drilled. The D-7 is also used for work around the quarry requiring a heavy-duty tractor.

Drilling and Blasting

A recent blast in the southeast corner of the south quarry face consisted of 13 holes, each 6¼ in. in diameter. These holes varied from 21 to 34 ft. in depth; the burden and spacing were 14 by 16 ft. in the low face and 18 by 20 ft. in the high face. The holes were drilled by a recently purchased Joy Middleweight Champion well drill, which replaced two churn drills. Hughes and Chicago Pneumatic Tricone bits were used in drilling the 6¼-in. holes. Penetration was satisfactory although the very hard and abrasive New Scotland formation presented some difficulties from the standpoint of bit life, it being necessary to change bits every 600 to 800 ft. In the other stratum the bit life often goes as high as 1,300 ft.

The vertical drill holes, subdrilled

A PRIMARY BLAST: This 13-hole blast resulted in 8,760 net tons of well-fragmented rock which was easily handled by the shovel. The explosive ratio was 1 lb. of explosives to 3.6 tons of rock.

from 3 to 5 ft., are column-loaded with explosive. An average 30-ft. hole will contain a total of 225 lb. of explosives. The loading procedure (Fig. 1) consists of placing 25 lb. of 75% gelatin extra explosive, then 25 lb. of Gelamite®-D; on top of this is loaded 75 lb. of Dynatex®-B, then 25 lb. Gelamite-D and 75 lb. Dynatex-B. About 13 to 15 ft. of stemming in the form of rock fines from the Joy Middleweight Champion drill completes the loading. The Dynatex-B was packed in fiber drums, while the Gelamite-D and the gelatin extra 75% were packed in 23-G containers, size 5½ in. by 25 lb. Each hole is primed with Primacord,* and holes are connected by a trunk line of Primacord and MS connectors between holes.

The blast resulted in a well-fragmented, slightly inclined rock pile that made easy handling for the shovel. There was very little backbreak. Immediately after a blast and before any clean-up is started, a thorough examination is made of the area to detect any misfires or other dangerous conditions.

Deck loading is used only if the drill hole runs through some weakness in the rock strata. If the holes are clean, the cartridges are dropped; however, if it appears that an obstruction in the hole might cause a cartridge to hang, a lowering rope is used.

The 13-hole blast just described produced 8,760 net tons of rock, or 3.6 tons per lb. of explosives.

Because of the nature of the cap rock and the many mud pockets and seams encountered, a portion of the blasted material is too large for the shovels to handle and some secondary blasting is usually required. The drill holes for this type of blasting are made by Ingersoll-Rand Jackhamers, using a 1¼-in.-diameter Timken bit. Holes are loaded with Hercomite® 4 in 1 by 8-in. cartridges. Loads range from ½ to 1½ sticks per hole. These secondary blasts are detonated by regular blasting caps and Quarrycord.*

Air for the Jackhamer is supplied by a 315-cu. ft. Chicago Pneumatic air compressor. All large boulders thrown back by the shovels while loading and any large rock from a primary blast that can be reached are broken by a Model 362 Marion on which is

*Reg. U. S. Pat. Off. by The Ensign-Bickford Company

mounted a 6,000-lb. forged steel drop ball on a 60-ft. boom. Use of this machine has eliminated 85 to 90% of the secondary blasting.

After blasting, the broken rock is loaded out by Bucyrus-Erie shovels which are equipped with 2½-cu. yd. dippers. These two shovels have Ward-Leonard controls. A fleet of Mack 10-cu. yd. rear-dump trucks, powered by 200-hp. Cummins diesel engines, haul the broken rock about one mile to the primary crusher. The blast area around the shovel is kept clean and the stone piled up by a Model 180 Michigan dozer. Cement manufacturing requirements for stone of varying chemical composition dictate the frequency and location of primary blasts.

Ramp Development

The normal blast in the ramp-development program consists of a total of 55 three-in. holes divided in three rows on a 5 by 5-ft. spacing. The depth, of course, varies because of the 6% grade; the extreme depth is 23 ft. These holes are made by a Chicago Pneumatic Tracdril using a 3-in. Timken bit with a carbide insert, and subdrilled to 3 ft. below grade. A ramp shot of 55 holes will require approximately 1,280 lb. of Gelamite 2 packed in 2½ by 16-in. cartridges. The blast is detonated by Primacord. Approximately 3,840 net tons of stone, or about 3 tons per lb. of explosives, are produced.

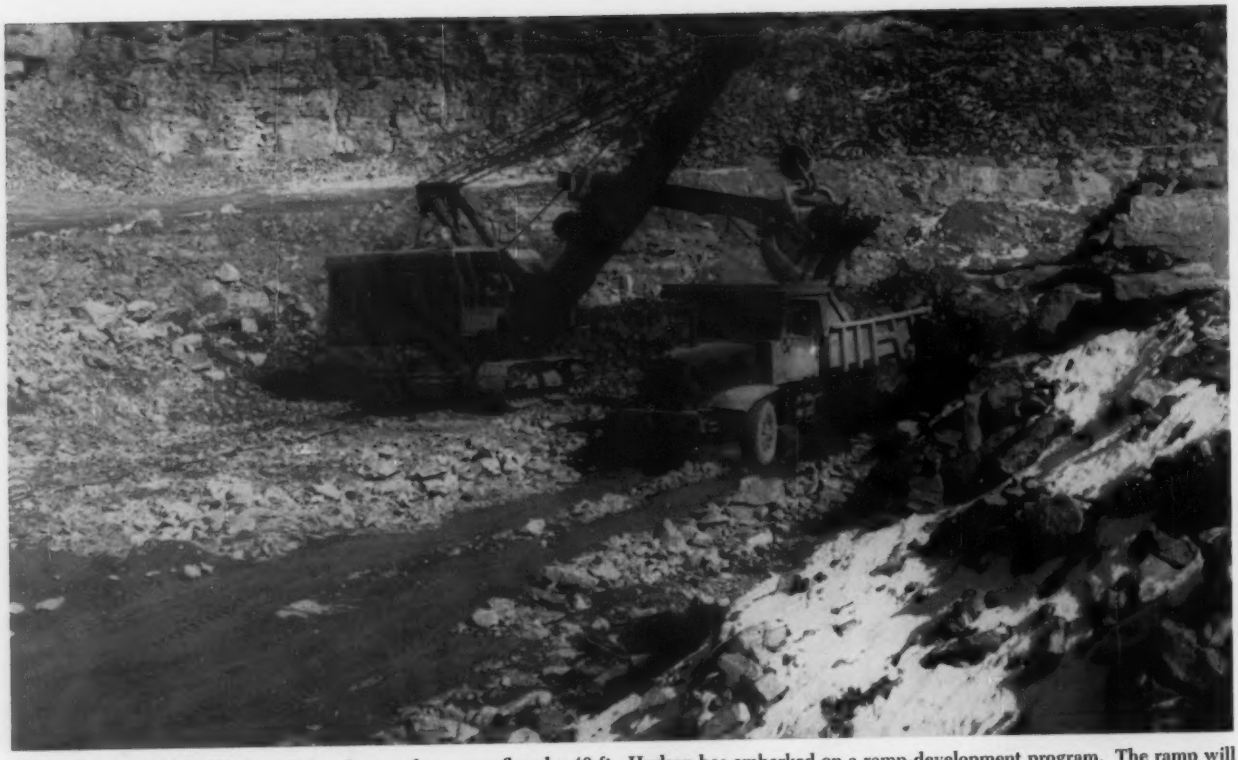
Air for the Tracdril is provided by a Chicago Pneumatic compressor with a capacity of 600 cu. ft. minimum.

A crusher unit with the most modern and time-saving equipment was erected in 1936. The primary crusher is a 42-in. Traylor gyratory which reduces the rock to 6 in. in size. This rock is then further processed in a Pennsylvania reversible hammermill producing 1½-in. material. From the crusher the stone is transported 1,200 ft. across the valley by belt conveyor to the cement plant.

Safety Program

The combination of careful planning and the employment of modern equipment and operating techniques has made the Hudson Quarry not

ROCK REMOVAL: The slightly inclined rock pile is easily handled by the electric-powered Bucyrus-Erie shovels. Broken rock is transported by Mack 10-cu. yd. rear-dump trucks.



RAMP DEVELOPMENT: In order to deepen the quarry floor by 40 ft., Hudson has embarked on a ramp-development program. The ramp will be on a 6% grade and will be 60 ft. wide and 700 ft. long.

CHECKING PRODUCTION: Thomas D. Warke, Jr., assistant quarry foreman, and Charles W. Sheldon, quarry foreman, go over the rock-production report to determine the effectiveness of a primary blast in the south quarry face.

only a model of efficient operation, but also the holder of an enviable safety record. At the time of the author's visit, the employes of the quarry had worked nearly 3,000 calendar days without a lost-time accident. The safety program is a well-thought-out and coordinated activity. A training program, given all new employes to qualify them for the safe conduct of their jobs, is the first step. Thereafter, close and constant personal observation by the supervisory personnel makes sure that any unsafe practices are eliminated.

All visitors at this plant are required to register, or sign in, at the main office, where they are furnished with a hard hat and a pair of safety glasses before being allowed to visit operations.

Personnel

The entire Hudson operations are under the direct supervision of R. D. Mayne, plant manager. He is assisted by J. E. Jenks, assistant plant manager. The quarry foreman is Charles W. Sheldon and the assistant quarry foreman is Thomas D. Warke, Jr.

NEW CRAWLMASTER DRILL

packs more weight, power and versatility than any other machine in its class

AT A LARGE Southern Granite Quarry, this Gyro-Flo powered Crawlmaster demonstrated its super-slugging power by out-drilling two larger-bore machines in competitive performance tests. With its new super-power D-525 Drill and constant-pressure hydraulic feed and retraction, the Crawlmaster rated highest in both average and maximum penetration in all tests. Capable of percussion, rotary or Downhole drilling of 4" to 6½" holes in any position from vertical to horizontal, this 11-ton machine with dozer-type crawlers has the weight and stamina to handle the toughest drilling jobs. Features include all-hydraulic tower positioning, four 30" stroke leveling jacks, remote-controlled reverse rotation and simple ejector-type dust collector.

An Ingersoll-Rand 900-cfm Gyro-Flo rotary compressor provides ample power for all drilling and moving functions. With other interchangeable drill combinations, a 600-cfm unit is ample. But whatever the size, Gyro-Flo's traditional dependability, smoothness of operation and exceptional freedom from maintenance make it the ideal Crawlmaster power supply. Low oil consumption, air temperatures under 200°F and closer regulation all the way from no load to full load contribute to lowest possible air power costs.

Ask your I-R distributor or engineer for complete information on the cost-cutting Crawlmaster Gyro-Flo combination.

Ingersoll-Rand IR

66A14 11 Broadway, New York 4, N. Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK.

NEWS NOTES

STUDENT-TRAINEE PLAN IN MINING ENGINEERING

A student-trainee program to supplement the regular four-year curriculum in mining engineering is being inaugurated by Penn State for summer, 1960. The new plan resulted from concern about the shortage of engineers entering the mining industry in contrast with the demand and opportunities for young men in this field.

The program will go into effect in July. Students enrolling in the program will attend school six months, then work in industry six months, over a four-year period. The fifth year they will remain in school continuously. The curriculum to be followed will be identical with the present one but will be rearranged to permit the student to obtain his bachelor of science degree in five years. Interested candidates are urged to apply immediately to Pennsylvania State University, State College, Pennsylvania.

NATURAL GAS ENGINES BOOKLET

The complete line of Caterpillar natural gas engines for all applications is described in an eight-page booklet issued by Caterpillar Tractor Company, Engine Division, Peoria, Illinois.

The booklet traces the development of the natural gas engine at Caterpillar; shows model views, specifications, and fuel consumption curves of current models.

The booklet contains photographs and job stories illustrating actual performance of Cat natural gas engines in drill rig, cotton gin, irrigation, gas compressor, pipeline, air-conditioning, sewage disposal, gas separation, electric, standby, and other installations.

BULLETINS DESCRIBE SLUSHERS

Joy Manufacturing Company has available for free distribution two new bulletins covering the company's line of lightweight air- and electric-driven slushers. Bulletin 76-F describes 5-hp. Model S-211 slusher which, according to the manufacturer, has a rope pull of 1,100 lb. and which measures only 27 by 21½ by 14½ in.

Slusher Model FF-211, the subject of Bulletin 76-G, has ratings of 7½, 10, and 15 hp., pulls a maximum (rated) 2,500 lb. It comes in two- and three-drum versions with respective lengths of 39½ and 51 in. with short-length motors, respective widths of 25 and 29 in., and a height of 23 in.

The company states that newly developed Joy Pistonair air motors provide extremely high starting and operating torque on air-driven models of both lightweight slushers.

PILE HAMMER BULLETIN

A new bulletin describing the complete line of McKiernan-Terry diesel pile hammers is now available. The new addition to the line, the DE-40, 4,000-lb. ram, 24,000 ft.-lb. per blow diesel hammer, is featured. Full information covering the operational features of the hammers, description of the operating cycle, design features, specifications, drive caps available, and engineering data covering the energy rating and static load-bearing capacities of the hammers are given. For your copy of Bulletin No. 674, write to McKiernan-Terry Corporation, Dover, New Jersey.

FOLDER DESCRIBES COMPRESSORS

A new four-page folder describing its stationary air compressor line including data on its "Twin-Air" rotary screw-type machines which deliver up to 19,400 c.f.m. at 100 p.s.i. has been published by Atlas Copco, producer of air compressors and pneumatic equipment. Copies are available from Atlas Copco, 545 Fifth Avenue, New York 17, New York.

SWITCH CATALOG

A new catalog on high-performance toggle switches and toggle switch assemblies for use in airborne, mobile, marine, electronic, and commercial applications is available from Micro Switch, Freeport, Illinois. Catalog 73P includes a wide selection of military versions that have been tested and approved under MIL-S-3950A, as well as pull-to-unlock, hermetically sealed, "electrical memory," rocker-actuated, and miniaturized designs. There are 32 pages of detailed descriptions, photographs, diagrams, dimensional drawings, and specification tables.

SAFETY PAMPHLET

"Who gets hurt in industrial accidents?" is a question asked—and answered—by a new pamphlet published by the National Safety Council.

The pamphlet entitled "Who Gets Hurt?" uses a humorous approach, multicolored cartoons, and concise text to discuss on-the-job injuries. It says the man who gets hurt is the man who thinks he's invulnerable.

The 16-page pamphlet explains the type of worker most likely to be accident-prone, how workers and their families are hurt in accidents, where accidents happen, what injuries cost the worker and his family, and what you can do about accidents.

A single copy of "Who Gets Hurt?" may be obtained free from the National Safety Council, 425 N. Michigan Avenue, Chicago 11, Illinois.

DIAMOND DRILL BITS DESCRIBED

Detailed information, including specifications, assembly data, and prices, on Asco diamond drill bits, is presented in a new illustrated catalog from Anton Smit & Company, Inc., New York, designers and manufacturers of diamond drill bits for mining, industrial, construction, and exploration applications.

In addition to illustrations and descriptions of the company's extensive line of coring and noncoring drill bits, casing bits and shoes, reaming shells, blast-hole and pilot bits, the catalog also contains information on ordering standard and special drill bits, plus a brief description of the manufacturing methods and standards for Asco diamond drill bits.

Catalog No. 502 is available free from Anton Smit & Company, Inc., 111 Eighth Avenue, New York 11, New York.

VIBRATION EFFECTS ON
STRUCTURES · WELLS · PIPE LINES

HAROLD H. WHITE
CONSULTING ENGINEER

2831 EAST 14TH STREET, JOPLIN, MISSOURI

Seismic Surveys for Sub Surface Exploration — Seismograph . . . Accelerograph
Electronic Comparascope — Micro Barograph Surveys
Investigation of Explosions and Explosives Accidents

VIBRATION TROUBLES?

EXPLOSIVES USERS — If you are experiencing or anticipate legal or public relations problems arising from blasting effects—

Send For Our BROCHURE *Describing Our Services*
(Price Schedule Accompanies Brochure)

Seismograph Protection — Vibra-Log Service — Seismograph Rentals and Sales
Preblast and Postblast Property Inspections — Condition Surveys and Appraisals
Seismic and Resistivity Rock Depth Surveys
Rock Velocity and Impedance Measurements

THE VIBRATION ENGINEERING COMPANY, INC.

407 Hazleton National Bank Bldg. • Phone: GLadstone 5-1961 • Hazleton, Pa.

Pittsburgh Area Office
Philip R. Berger, Mgr.
Bradford Road
Bradfordwoods, Pa.
Phone: WEstmore 5-1655

B. F. Howell, Jr., Ph.D., P.E.
Chief Seismologist

Affiliated with
Frank Neumann, Seismologist
4546 45th Ave., N.E.
Seattle 5, Wash.
Phone: Lakeview 4-0028

830 ft. every 9 hrs.

in hard formation with REICHdrill

. . . we've never even come close to this with any competing rig

Construction job performance like this is standard with REICHdrill. Why? Because:

. . . all-hydraulic top-drive rotary provides infinitely variable speed of drill rotation – the right speed for every formation.
. . . direct-drive to drill stem saves power loss.
. . . all air used to drill and clean hole.
. . . no complicated transmission, no rotary table.
. . . no kelly bar – in and out of the hole faster.
. . . instant safety torque release protects all drive components.

REICHdrill has built a reputation for keeping maintenance costs low; footage records high.

And these additional REICHdrill features help set drilling records: masts incline for angle drillings; CP heavy-duty compressors assure plenty of air to meet all demands; fast-acting, ram-type hydraulic leveling jacks permit use of most rig weight for down pressure; CP "Air-Blast" Bits for extra footage in toughest formations.

For further information write:

REICHdrill
1439 ASH STREET, TERRE HAUTE, INDIANA
Division: CHICAGO PNEUMATIC TOOL CO.

T-650 truck-mounted REICHdrill in operation on construction work. Hole size: to 7⅞"; down pressure: 30,000 pounds. Other models available, truck or crawler mounted, with hole size to 16 inches, down pressure to 90,000 pounds.

This unretouched photograph shows a multiple hole blast detonated with Primacord, and hooked up with Primacord M/S Connectors in the trunk line. Note the steady progress of this blast from the point of initiation at the left as indicated by the red line.

Millisecond Delay Blasting with Primacord and

PRIMACORD M/S CONNECTORS

can provide you with these 8 advantages:

One of the primary purposes of millisecond delay is to provide relief between holes or rows of holes. When properly relieved, each succeeding charge "takes the line of least resistance." This condition usually results in

1. Less explosive required than for comparable instantaneous blasting.
2. Better fragmentation.
3. Less vibration and concussion.
4. Better control of throw or displacement.
5. Reduction of "toe" and undesirable backbreak.

Primacord will initiate all cap-sensitive explosives, but is insensitive to detonation by stray electrical currents, sparks or ordinary shock. When Primacord is used for all in-hole priming and to connect all holes, you have these additional advantages:

6. The work of loading the blast can follow the drillers. The holes can stand loaded and Primacord primed until everything is ready for the blast.
7. Danger of a premature blast is minimized. You detonate the Primacord trunk line with fuse and cap or electric blasting cap attached *only when all is ready for the blast.*
8. Less chance of missed holes with unexploded powder and caps in the muck.

The Primacord M/S Connector is a non-electric delay device. It consists of a metal tube containing a delay element in the center with a series of adjacent charges at each end. A piece of Primacord about 12" long is crimped onto each end of the metal tube. The Primacord M/S Connector is constructed symmetrically about the center and therefore functions in either direction. The Connectors are used by simply cutting the Primacord trunk line at the spot where the delay is desired and tying the Connector to the cut end of the Primacord trunk line with a square knot. Packed 50 to a cardboard tube, 500 to a case. Manufactured by E. I. duPont de Nemours & Company. Available through all explosives suppliers.

The ENSIGN-BICKFORD COMPANY

Simsbury, Connecticut • Since 1836

MS-2

GET NEW MOBILITY FOR DRILLS UP TO 6 INCH BORE

with the JOY TDH Trac-Drill

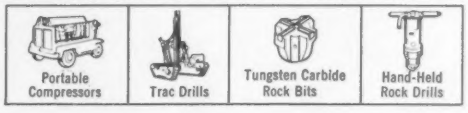
The new Joy TDH Trac-Drill is a sure-footed carrier for Joy's powerful 5¼", 5½" and 6" bore percussion drills. Rugged enough to support these large drills with ease, it is also amazingly flexible and mobile. The TDH moves quickly, (at speeds up to 60 fpm), over the roughest ground because its crawler tracks are free to oscillate —to move and swivel independently of each other.

Wide track gauge, 85⅞" center line to center line, and long tracks (88" of ground contact with each track) gives the TDH positive traction and stability. Mounted low on the frame for stable support, the mast handles 20 foot steel changes, and can be hydraulically positioned to drill at angles from 15° in front of vertical to 10° above horizontal.

A big drill for big jobs, the TDH requires just one man for all operations. All machine functions are power-controlled from the operator's station. Have your Joy representative arrange for you to see this flexible, big-hole drill, or write for Bulletin 1419-82.

JOY CONSTRUCTION EQUIPMENT IS SOLD AND SERVICED BY THE JOY DISTRIBUTOR IN YOUR AREA

JOY



Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

HERCULES® ELECTRIC BLASTING CAPS HELP SET WORLD'S RECORD IN TUNNEL DRIVING

"Setting a world's record," says Clancy O'Dell, project manager of the recently holed-through New York City's West Delaware Tunnel, "is largely a combination of loyal skilled tunnel workers and the best and most dependable equipment and supplies." And he should know, for the boring of this 43.64-mile-long water tunnel was finished in the record time of 841,000 man-days, or ten months ahead of schedule.

On this project, the West Delaware Tunnel Constructors also drove a record 2,177 linear feet in a single 31-day period and established a shaft-sinking record of 243 linear feet for a like period.

Hercules® Short-Period Delay Electric Blasting Caps, used almost exclusively in all phases of blasting activity on the West Delaware Tunnel, proved their dependability and efficiency in helping to establish these records.

For complete information on how No Vent® Short-Period Delay Electric Blasting Caps can be applied to your job, call your Hercules representative or write direct to the office nearest you.

Explosives Department

HERCULES POWDER COMPANY

INCORPORATED

900 Market Street, Wilmington 99, Delaware

XR60-4

BIRMINGHAM, ALABAMA · CHICAGO, ILLINOIS · DULUTH, MINNESOTA · JOPLIN, MISSOURI · LOS ANGELES, CALIFORNIA
NEW YORK, NEW YORK · PITTSBURGH, PENNSYLVANIA · SALT LAKE CITY, UTAH · SAN FRANCISCO, CALIFORNIA